An Energy Efficiency Workshop & Exposition

Palm Springs, California

Modular Technology for Large Integrated Energy Systems

The Journey of a CCHP Project

- Fort Bragg Overview
- Honeywell Role at Fort Bragg
- Energy Management Strategy and Structure
- Central Heating and Cooling Plants
- CCHP Evaluation – Phase 1
- DOE Award
- Final? Cycle Design of Retrofit Project
- Conclusions

Fort Bragg Army Post

- Mission
  - Home of 44,000 Soldiers
  - 82nd Airborne, Special Forces & Others
  - Simmons Army Airfield
  - Pope Air Force Base
- Public Works Infrastructure – Municipal Utility
- Energy Consumption
  - 450 x 10^6 kWh of electricity per year
  - 100 MW Peak Demand
  - 1.5 BCF of gas per year

Honeywell Roll at Fort Bragg

- Energy Savings Performance Contractor
- ESPC – TEAM Contracting Vehicle
  - Over $51.6 million in improvement projects
  - Annual energy savings of over $8.5 million
- Energy Strategy -Integrated Supply Chain Management
  - Reduce Energy Cost - Demand, Distribution, Supply
  - Manage Energy Risk – Both physical and financial
  - EO-13123 Energy Efficiency

Improve the Quality of Life for Soldiers

ESPC Energy Supply Chain Initiatives

- Demand-Side
  - HVAC, Controls, Lighting, On-site generation
- Distribution
  - Central heating & cooling plant modernization
- Supply-Side
  - Gas procurement, support utility contract negotiations, support utility rate intervention
- Energy Information System
  - Central Energy Control Cockpit
  - Monitoring, trending, analysis, fuel mgmt., RTP load management(markets, forecasting), M&V reporting

Central Plant Operations

- Plant modernization program
  - Chiller replacements
  - Controls / monitoring upgrades & integration
  - Primary / Secondary chilled water distribution
- Honeywell operates & maintains central heating and cooling plants.
- Candidates for CCHP - four plants
- 82nd Division Heating Plant Selected for CCHP– newest and largest

82nd Heating & Cooling

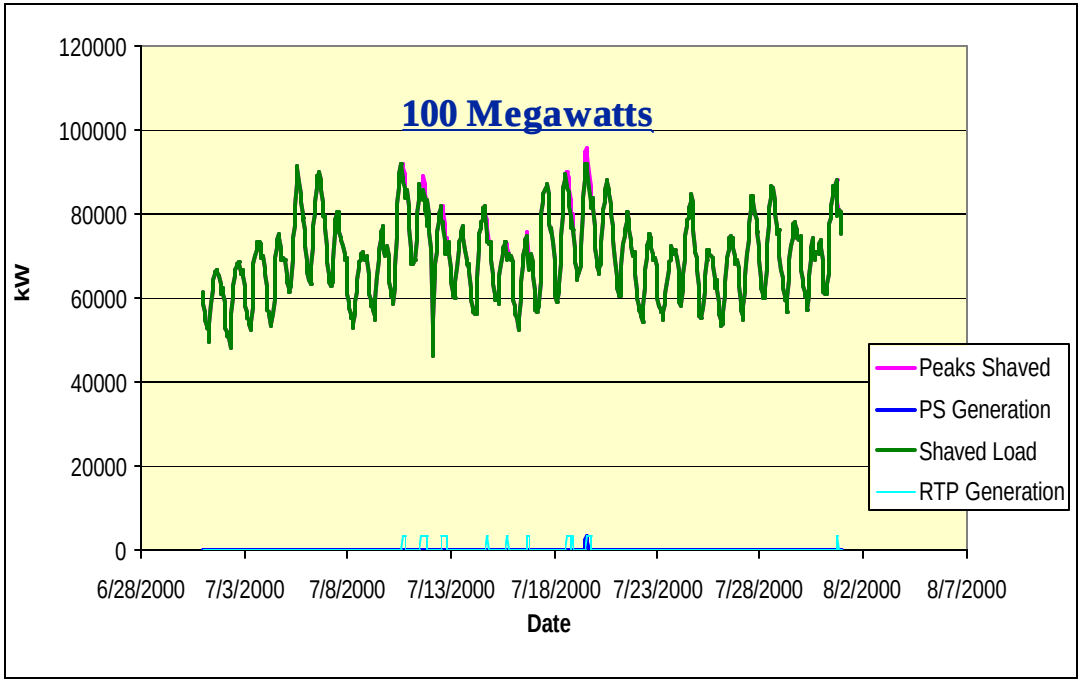
- Thermal load –
  - Continuous Steam and hot water to 100 buildings and 3.1 million ft^2 (120 x 10^6Btu / hr)
  - Chilled water load 500 tons (another 3,000 tons provided by 82nd Cooling Plant)
- Electrical connections, close to 3 primary circuits & a main substation
- Renovation & expansion program – Barracks and Admin. Bldgs.
- Four existing unreliable boilers

CCHP Challenges – Modularity a Solution?

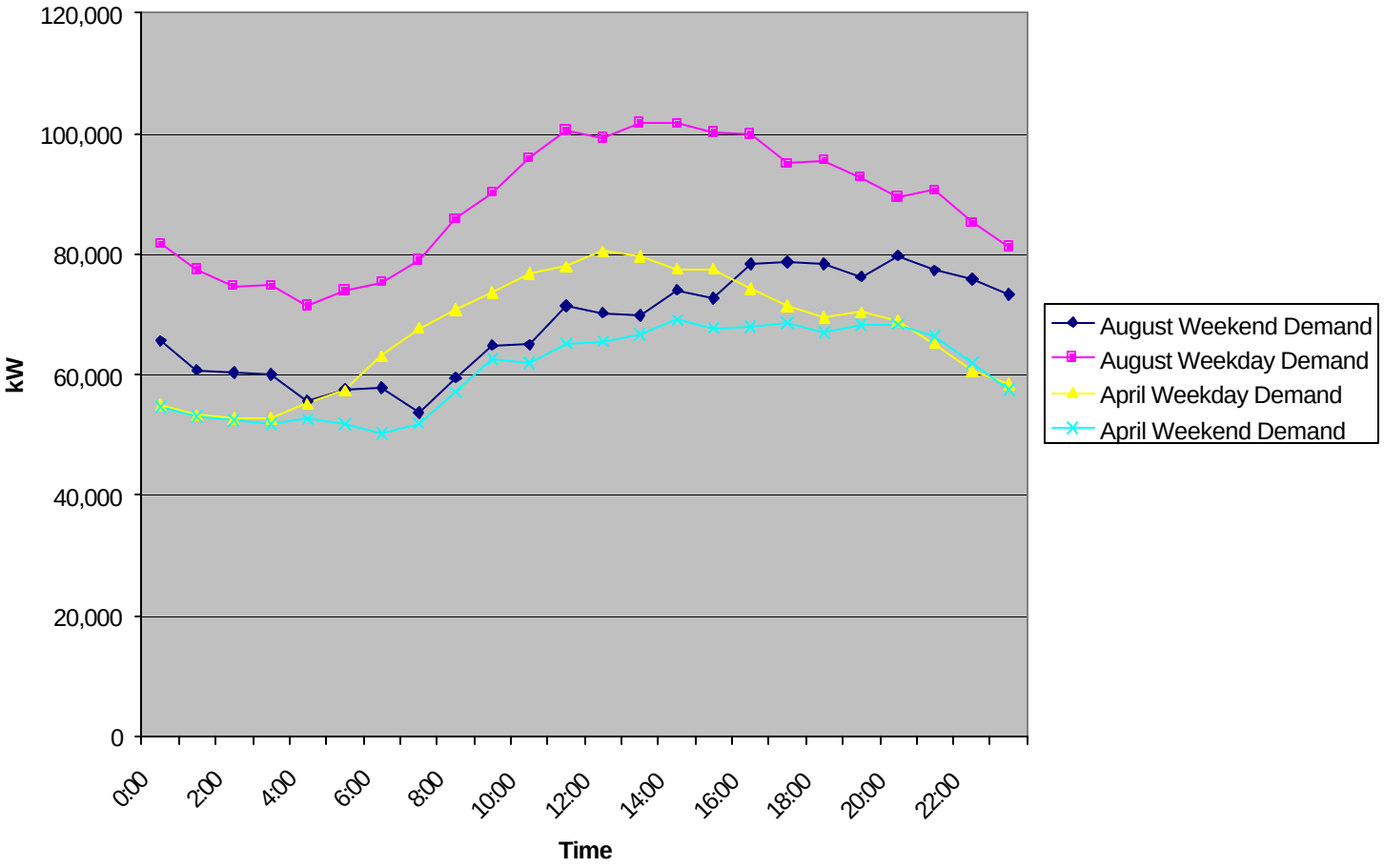
- Capital Cost
  - Over $1,000 / kW construction cost
  - Plus NG piping, development, engineering, financing, O&M
- The spark spread
  - Competition – base load energy from central power plants
  - Natural gas price volatility
  - Natural gas LDC charges
- Technical complexity
- Government / DOD budgeting process – maintenance budget is last, utility bills are must-pay
- Monopoly (regulated) utility tariff structures and rules designed to discourage on-site generation

Peak Loads Due to Air Conditioning, The Real Challenge at Fort Bragg

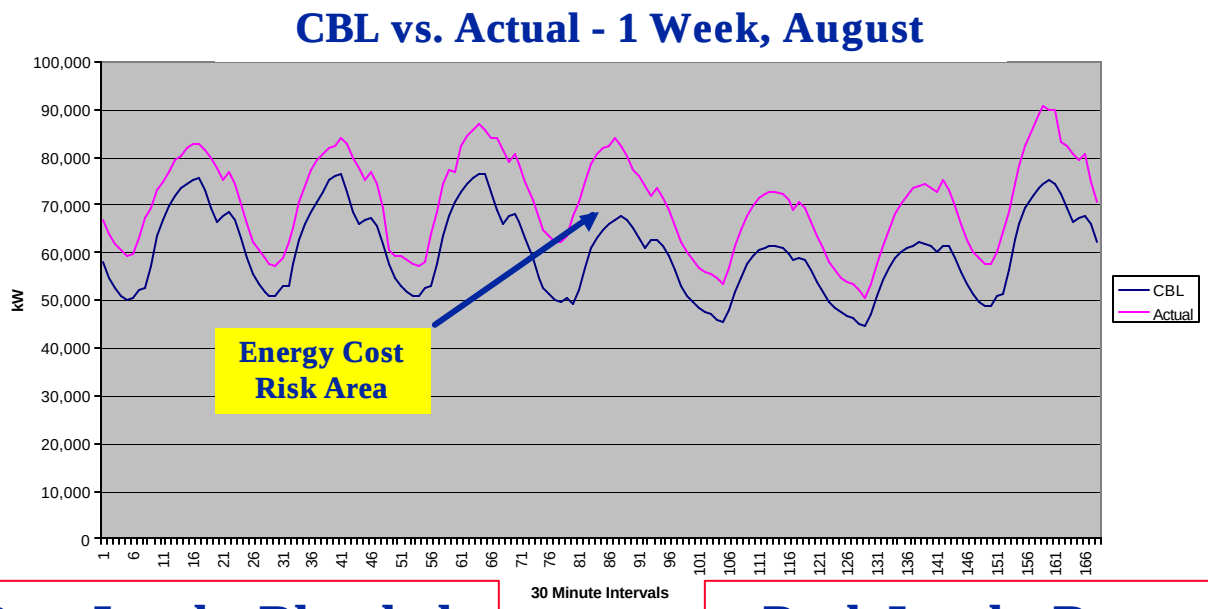
July – Peak Loads



Summer,Spring Average Daily Profiles



Real-Time Electricity



Base Load – Blended Average -$.042/kWh

Peak Load – Range $.09/kWh -$.90/kWh

Fuel Procurement

Dual Fuel Capability

Natural Gas

- Low Emissions
- Efficient
- Price Risk Management

Fuel Oil

- Emergency backup
- Allows interruptible gas
- Ceiling price for gas

Initial Evaluation Publication

"CHP Demonstration Projects at Federal Facilities" The FEMP Role

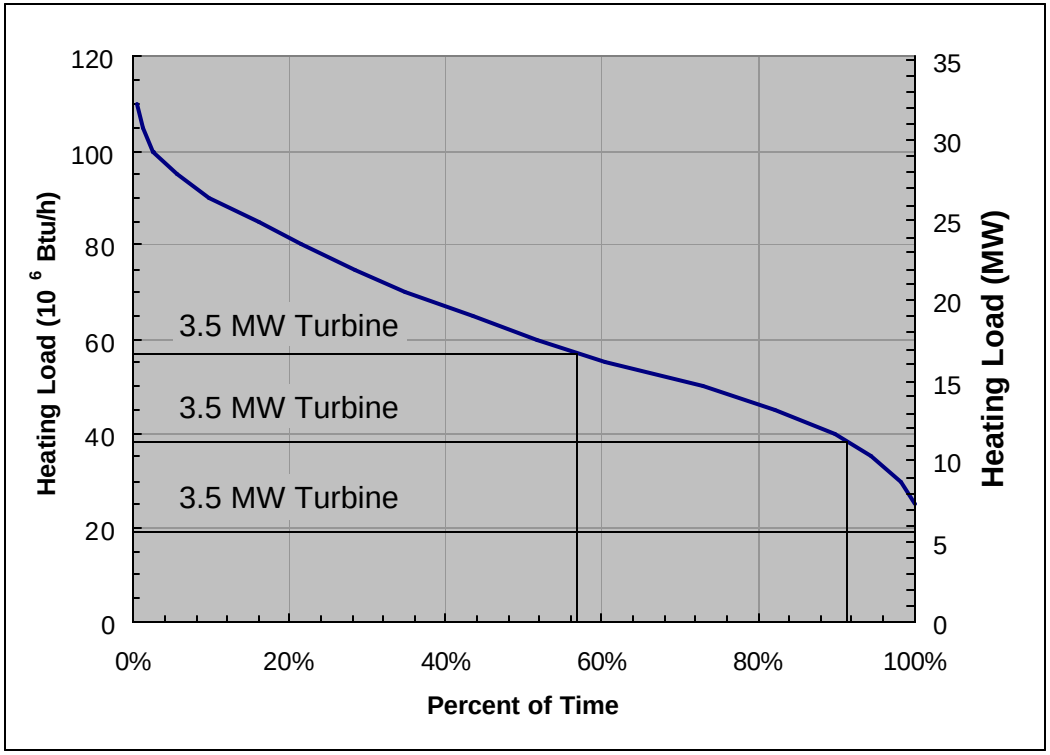
Oak Ridge National Labs

- **Steve Fischer**
- **Patrick Hughes**

CDH Energy

- **Steve Carlson**
- **Hugh Henderson**

Initial Configuration & Heating Load Distribution



Initial Configuration - Conclusions

Thermal Load

- **Hourly vs. Daily**
- **Uncertainty of future load**

Savings

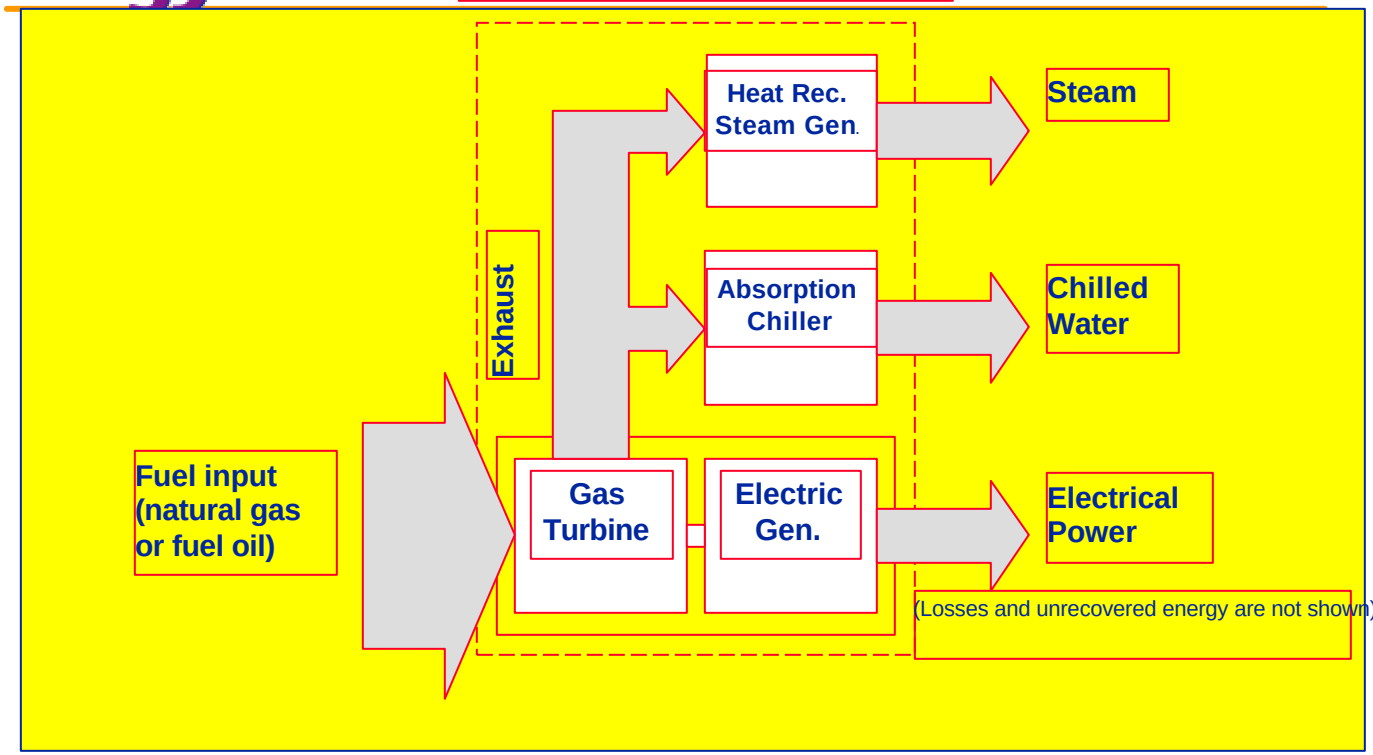
- **Electricity Demand**
  - **Contract vs. Use**
  - **The regulated version of RTP**

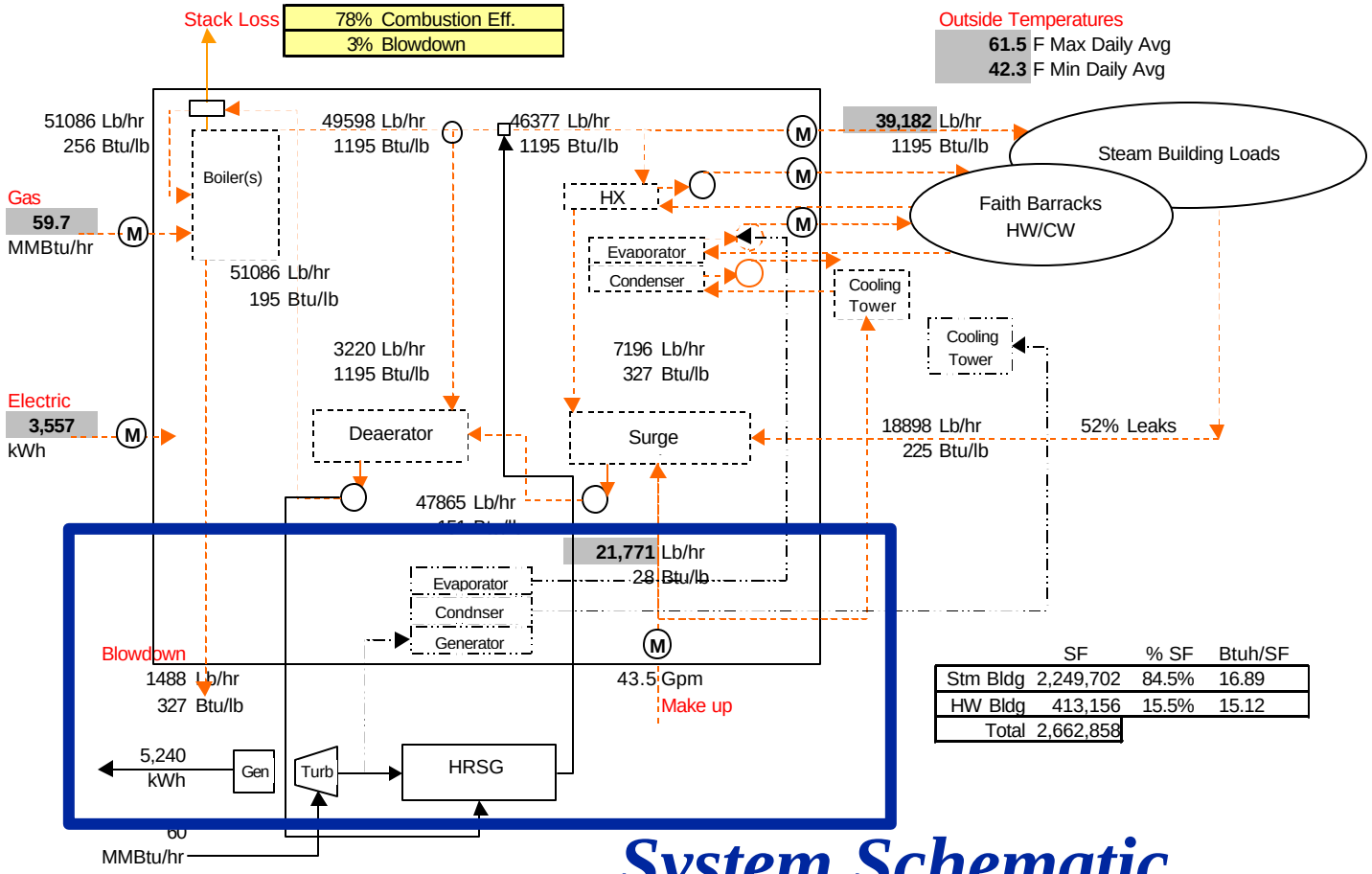
Final Configuration?

- **Single 5 MW Turbine-generator**
- **HRSG & Chiller**
- **Inlet Cooling**
- **Plant Controls Upgrade**

1. **Lower Capital Cost**
2. **Higher Savings**
   - **Demand reduction offsets growth**
   - **Baseload**
   - **Full Utilization of thermal load**

DOE Reference Modular Design





System Schematic

Bold black values are average measurements for 16 days from 2/2/02 to 2/18/02

Reference Design Challenges

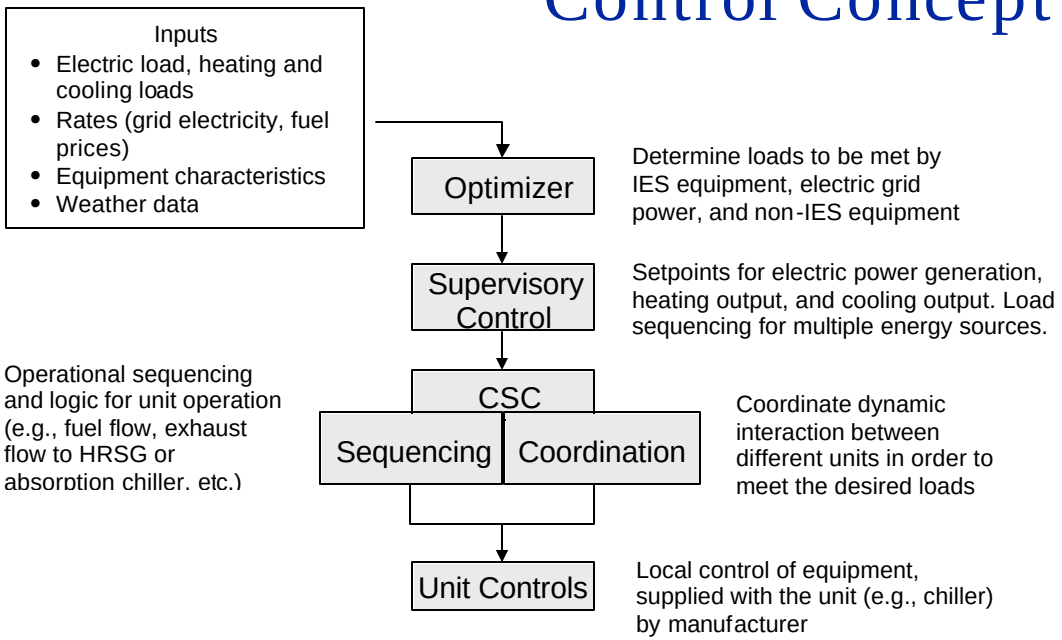
- Applications for large, CCHP projects
- Standard design for retrofits
- Indirect fired absorption chiller – ductwork
- Absorption chiller cyclical loads
- Operational optimization
- Capital requirements
- Project complexity

DOE - Integrated Energy Systems Focus

- Self-funding combined heat & power
- Operational optimization
  - Forecasting & load management – currently operating
  - Fuel switching, cycle optimization – being developed.
- Chiller implementation – 1000 Ton
  - Indirect fired – ductwork, flue gas controls
  - Steam
  - O&M

Optimization & Supervisory Controls

Control Concept



Conclusions

The Fort Bragg design is applicable at:

- **Very large installations and/or**
- **Very large thermal loads**

Most large government facilities have limited thermal load and/or limited occupied hours

- Less than 2 MW baseload
- Heating & cooling demands track occupancy and temperature.

Conclusions

- **Integrated Energy Systems are critical for efficiency and risk management.**
- **Stand-alone retrofit projects are difficult to justify and implement as efficiency improvements, only.**
- **Integrated Energy Systems should be seriously considered when central plants are expanded or renovated.**

Next Steps - Modular Design Study

Marketing Study

- **Most needed sizes**
- **User willingness to consider life-cycle cost in capital investments**
- **Gas market forecast**

Engineering & Cost Analysis

- Cycle design
- Recip vs. GT's
- Environment
- Packaging
- Optimization value